IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
NON-PROVISIONAL APPLICATION FOR UNITED STATES LETTERS PATENT

Title: HARVESTING MACHINE

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RELATED APPLICATION

This application claims the benefit of U.S Provisional Application Serial No. 60/394,454, filed July 8, 2002.

FIELD OF THE INVENTION

This invention relates to a harvesting machine and, more particularly to a machine for facilitating the manual harvesting of citrus and other varieties of tree grown fruits and produce.

BACKGROUND OF THE INVENTION

Citrus and other types of fruit have traditionally been harvested manually. This type of work is quite labor intensive and therefore costly. Moreover, persons picking fruit and other varieties of tree grown produce by hand have been required to use unwieldy ladders to reach the higher levels of the tree. This has created a serious risk of falls and resulting injuries. As a result, worker's compensation costs in the fruit harvesting industry have increased dramatically. Manual harvesting also presents various problems associated with a transient and poorly educated work force. Recently, immigration and security

issues have made the citrus industry's almost exclusive reliance upon such workers increasingly undesirable.

Various mechanized solutions have been proposed for the harvesting industry. For example, an assortment of shakers and canopy penetrators have been utilized to retrieve fruit mechanically. Each of these known devices exhibits certain problems, however. Such machines tend to be incredibly expensive. In many cases they are not suited for the particular grove or produce being harvested, or for the particular harvesting season. Known mechanical harvesters also tend to excessively damage the tree and create considerable debris. In many cases, a significant amount of fruit is missed during the mechanical harvesting process. Due to these difficulties, manual harvesting is still the preferred means of picking fruit.

"Cherry picker" machines have recently been used to improve manual harvesting. Typically, a single individual is raised and lowered in a bucket supported at the end of a mechanically operated boom or lift arm. The collected fruit is either dropped to the ground for later collection or deposited in a container carried on the bucket. Neither technique is optimally efficient. In the former case, additional workers must accompany the machine to collect fruit that is dropped on the ground. Once again, this technique is labor intensive, inefficient and costly. In addition, fruit can be damaged when it is dropped a considerable height to the ground. Depositing the picked fruit into a bin or container carried by the bucket is also quite inefficient. Each time the bin or basket is filled, the boom or lift arm must be lowered so that the fruit can be emptied into a larger container or hopper. In order to completely harvest the tree, the boom must be gradually raised and lowered so that the

worker can collect produce from each level of the tree. The harvesting process is therefore quite time consuming, particularly when the machine must be maneuvered through many rows of fruit or other produce bearing trees in order to complete the harvesting process. Currently, no machine is available which allows multiple rows of fruit growing trees in a grove or orchard to be harvested simultaneously and at different heights utilizing the same machine.

SUMMARY OF THE INVENTION

It is therefore the object of this invention to provide a harvesting machine that allows citrus and other fruits and produce to be harvested much more quickly, efficiently, and cost effectively than in the past.

It is the further object of this invention to provide a harvesting machine which largely eliminates the problems often associated with manual harvesting and conventional mechanical harvesters.

It is the further object of this invention to provide a harvester that significantly reduces the risk of worker injury and attendent worker's compensation costs.

It is the further object of this invention to provide a harvester that permits produce bearing trees to be more efficiently and fully harvested and which does not damage the produce or the trees during the harvesting process.

It is the further object of this invention to provide a harvester that allows multiple rows of produce bearing trees to be harvested simultaneously and at various heights using a single machine.

It is the further object of this invention to provide a harvester that permits large quantities of fruit or other produce to be quickly and efficiently without causing excessive damage to either the harvested items or the tree.

It is the further object of this invention to provide a harvesting machine that provides for many of the benefits of manual harvesting but which, at the same time, reduces significantly the labor costs and other problems associated with manual harvesting.

It is the further object of this invention to provide a harvester that is suitable for use with all types of tree grown fruits and produce and in all types and sizes of groves and orchards.

This invention features a machine for harvesting produce from a pair of adjacent, generally parallel rows of produce-bearing trees. The machine includes a land vehicle having a chassis for being driven between the adjacent rows of trees. The chassis supports a fruit collection receptacle. At least one pair of selectively extendable and retractable lift arms are pivotally mounted to the chassis. Each arm in each pair supports proximate a distal end thereof a carrier for holding a person. The arm is adjustable to position the carrier such that a person in the carrier is able to manually collect produce from a respective one of the rows of trees. There are a plurality of conduits, each of which is interconnected between a respective one of the carriers and the receptacle for transmitting produce deposited into an entrance of the conduit by a person in the carrier and discharging the transmitted produce into the receptacle.

In a preferred embodiment, the lift arms are mounted on respective opposite sides of the chassis such that each arm is positioned to correspond with a respective one of the

adjacent rows of trees. A conveyor may be mounted to the chassis for transporting produce from the receptacle to a storage bin connected to the chassis. At least one chute may be attached to the chassis in communication with the receptacle for introducing produce collected from a location proximate ground level into the receptacle. Each arm may be telescopically extendible and retractable. The lift arms may include a first pair of upper level arms for positioning respective carriers and persons therein so that such persons are able to collect produce from upper levels of the adjacent rows of trees. A second pair of intermediate lift arms may be provided for positioning respective carriers and persons therein so that such persons are able to collect fruit or produce from intermediate levels of the adjacent rows of trees, which intermediate levels are below the upper levels of the trees. The carriers may include respective buckets mounted proximate of distal ends of the lift arms.

The conduit may include a flexible pipe. The conduit may carry a funnel at the upper end thereof for facilitating introduction of collected fruit into the conduit.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Other objects, features and advantages will occur from the following description of a preferred embodiment and the accompanying drawings, in which:

FIG. 1 is a perspective view of a preferred harvesting machine according to this invention;

FIG. 2 is an elevational side view of the harvesting machine;

FIG. 3 is a top plan view of the harvester positioned between a pair of generally parallel adjacent rows of produce bearing trees; the lift arms are deployed to depict how the produce is manually harvested by workers in the respective lift buckets; and

FIG. 4 is a simplified elevational, cross sectional view of the receptacle and a conveyor which may be utilized in connection with the receptacle.

There is shown in FIGS.1-3 a harvesting machine 10 that is particularly suited for use in citrus harvesting. It should be understood, however, that machine 10 is suitable for use in harvesting all types of fruits or other types of tree grown produce. The particular type of produce harvested is not a limitation of this invention. As used herein "produce" is intended to include all varieties of tree grown fruits, nuts, vegetables and any other items which need to be periodically harvested. Machine 10 is particularly beneficial for use in groves or orchards having generally parallel rows of fruit bearing trees. The unique construction of the machine permits a pair of adjacent rows to be quickly, efficiently and simultaneously harvested.

Machine 10 comprises a land vehicle 12 that is adapted to be driven between adjacent rows of fruit or produce bearing trees in a grove or orchard. See rows R1 and R3 in FIG. 3. Land vehicle 12 includes a chassis 14 that supports a cab 16 at its forward end and a power unit 18 at its rearward end. Chassis 14 is itself mounted on a plurality of wheels 20. As is best shown in FIG. 3, all of the wheels are steerable and the forward wheels 20 are steerable independently from, and opposite to the rearward wheels. This permits machine 10 to be highly maneuverable so that the machine can be conveniently

It should be understood that various types of land vehicles may be used for machine 10. These may include vehicles wherein the cab and engine are integral with the chassis or body of the vehicle as shown in the drawings. Alternatively, the wheel mounted body or chassis may comprise an independent vehicle that is releasably connected to and pulled by a tractor, truck or other motorized vehicle. Land vehicle 12 may comprise anyone of a variety of motorized vehicles suited for use in agricultural or industries. The particular type of land vehicle utilized and the particular engine employed to drive the vehicle are not limitations of the invention. An assortment of alternative vehicle constructions, which will be understood by persons skilled in the art, may be utilized.

A forward pair of upper level booms or lift arms 22 are mounted in articulated fashion to a forward end of chassis 14 adjacent to cab 16. The lift arms are positioned on opposite sides of chassis 14. Each of the forward lift arms 22 comprises a plurality of telescopically interengaged components. The lower end of each lift arm 22 is mounted by means of an articulating component 24 to chassis 14. The articulating components 24 are themselves rotatably mounted to chassis 14 such that the forward lift arms are allowed to swivel or turn, relative to the chassis as indicated by double headed arrow 25 in FIG. 3. Each lift arm 22 is pivotable upwardly by and downwardly within its respective articulating component as indicated by double headed arrow 26 in FIGS. 1 and 2. Each lift arm is also selectively extendable and retractable in a telescoping manner as indicated by double headed arrow 28. Each lift arm is operated by appropriate controls in a manner that is described more fully below.

An analogous pair of intermediate level rear lift arms 30 are mounted in a similar fashion to chassis 14 rearwardly of forward lift arms 22. The rearward lift arms are constructed and operate analogously to the forward lift arms. In particular, each rearward lift arm is mounted to the chassis in an articulating fashion by a respective articulating component 32. As with the forward articulating components, each articulating component 32 is itself mounted to chassis 14 such that it swivels or rotates relative to the chassis as indicated by double-headed arrow 34 in FIG. 3. Each rearward lift arm 30 is pivotable up and down within its respective articulating component 32, as shown by double-headed arrow 37, and is selectively extendible and retractable as indicated by double-headed arrow 38. As is clearly indicated in FIGS. 1 and 3, each of the forward lift arms 22 is mounted on a respective side of chassis 14. Similarly, each of the rearward lift arms 30 is mounted on a respective opposite side of the chassis. This permits the booms of lift arms to be utilized simultaneously with adjacent rows of trees in a grove or orchard. The lift arms and associated articulating components are constructed of durable metal or metal alloy materials of the type used in agricultural and industrial "cherry picker" machinery. Appropriate pivots, bearings, fittings, sleeves and other components may be assembled in a conventional manner to construct the lift arms and articulating components.

A carrier 40 is connected proximate the upper distal end of each of the forward lift arms 22. A similar carrier 42 is likewise mounted proximate the distal or upper end of each rearward lift arm 30. More particularly, each carrier comprises a bucket, platform or other, preferably enclosed structure for supporting a respective worker W1 – W4. Each carrier 40, 42, is pivotally or hingedly secured to the upper end of its respective lift arm by

a hinge or pivot bearing 46. Various known types of bearings may be utilized. Once again, the buckets 40, 42 are preferably composed of a durable metal or metal alloy of type commonly utilized in "cherry picker" machines. Fiberglass may also be used. The forward lift arms 22 are typically longer, in their fully extended condition, than rearward lift arms 30. This allows the forward lift arms to be raised to an elevation so that workers W1 and W2 can service the upper levels of the trees in adjacent rows of the grove. Shorter rearward lift arms 32 are selectively extended to position respective workers W3 and W4 at somewhat lower, intermediate levels or heights within the adjacent rows trees. This permits all levels of the tree to be efficiently harvested in the manner described more fully below. It should be noted that, in alternative embodiments, the short lift arms may be positioned forwardly of the longer lift arms.

A fruit or produce receiving receptacle or reservoir 44 is mounted to or built within the chassis 14. In certain versions, receptacle 44 simply comprises a chamber, hopper or container having various sizes. In other versions, such as shown in FIG. 4, receptacle 44 may house a conveyor 46. The operation of this conveyor is described more fully below. Receptacle 44 includes a plurality of entry ports 48, FIG. 4, that are communicably engaged with the lower end of respective produce-transmitting conduits 50. Ground level chutes 52, FIGS. 1-4, are also formed in respective sides of receptacle 44. Conveyor 46 is operated by a known type of conveyor drive mechanism (not shown). As best shown in FIG. 4, receptacle 44 includes an opening 60 at its rearward end. The rearward end of conveyor 46 terminates proximate opening 60 and is operably connected to an elevating conveyor 62. This apparatus is likewise driven by a known type of conveyor drive

mechanism. In alternative embodiments of this invention, the elevating conveyor, as well as receptacle conveyor 46 may be eliminated and the receptacle may comprise a large bin or hopper into which fruit or other produce is delivered in the manner described below.

As shown in FIGS. 1-3, each fruit transmitting conduit 50 is interconnected between a respective carrier bucket 40, 42 and receptacle 44. More particularly, each conduit comprises a flexible tube, pipe or hose that is joined at its lower end to a respective inlet port 48 formed in receptacle 44. The opposite, upper end of each conduit is connected to a respective one of the carrier buckets. More particularly, a funnel 70 is attached to the outer wall of each bucket such that the entrance of the funnel is positioned proximate or slightly below the lip of the bucket. This positioning should allow the worker in the bucket to conveniently deposit fruit into the funnel. The lower end of the funnel is communicably secured in any acceptable manner to the upper end of a respective conduit pipe 50. Each conduit pipe may be formed of any reasonably light-weight, yet strong and preferably flexible material such as plastic or rubber. Duct work type piping and PVC pipes may be utilized. The lower end of funnel 70 is received by the upper end of pipe 50 so that the funnel communicates with the pipe. The pipes should be constructed so that they move easily and without kinking as the respective lift arms and buckets are manipulated during the harvesting process. As described more fully below, when picked fruit is deposited into the funnel, gravity typically causes the fruit to be transmitted through the conduit and to the receptacle. In certain embodiments, a vacuum-assist mechanism may be used to help propel the picked fruit through the conduit toward the receptacle.

Known types of controls and automated drive mechanisms may be utilized for operating the lift arms and attached buckets. For example, the lift arms may be pivoted, rotated and selectively extended and retracted by suitable hydraulic, electric, pneumatic and/or other known drive mechanisms of the type commonly used in the "cherry picker" industry. The controls may be located inside cab 16 and operated by a driver of vehicle 12. Alternatively, each individual lift arm and associated bucket may be controlled by the worker within the bucket by means of controls located in the bucket. These controls may be actuated by the operator's knees so that the individual worker can control positioning of his bucket while his hands remain free to pick fruit or other produce from the trees. The controls may be microprocessor driven and may be programmed to provide a pre-determined lift sequence and/or timing for each lift arm and associated bucket. In many cases, however, it will be preferred for each worker to be able to individually position his or her own bucket as needed to accomplish optimal harvesting. The various types of controls that may be utilized should be known to persons skilled in the lift and "cherry picker" industries and do not constitute a feature or limitation of this invention.

In operation, land vehicle 12 is driven and maneuvered between an adjacent, generally parallel row of trees, which are best depicted as rows R1 and R2 in FIG. 3. Independently steerable wheels 20 are turned as needed to maneuver machine 10 into the position suited for the particular location being harvested. The lift arms and respective buckets are then driven by the controls to position workers W1, W2, W3 and W4 as desired, relative to rows R1 and R2 of produce-bearing trees. More particularly, the forward arm 22 and rearward arm 30 on the left hand side of the machine position workers

W1 and W3 relative to the trees in row R1. The forward arm 22 and attached bucket 40 define an upper level picking station, which is driven by the appropriate controls to a height proximate the upper levels of the trees. This enables worker W1 to quickly and efficiently harvest fruit or other produce from such upper levels. As each item is picked, it is deposited by the worker into the funnel 70 associated with that bucket. The fruit or other produce then drops through the attached conduit 50 (by gravity and/or a vacuum-assist) and is discharged into receptacle 44 through inlet port 48. Similarly, the rearward, left hand lift arm 30 is operated to position worker W3 at an intermediate level, somewhat below worker W1. Produce is collected and transmitted to receptacle 44 in an analogous fashion. The operations of the forward and rearward lift arms are coordinated so that the respective lift arms, buckets and workers do not interfere with one another. Workers W1 and W3 may be able to control their own respective movements. Alternatively the movement of the buckets may be controlled within the cab or automatically as previously described. As a result, the forward and rearward lift buckets are moved in a pre-determined or desired pattern about the tree. Fruit is harvested quickly and efficiently. Because the fruit is deposited into and transmitted through the flexible conduits, it is not dropped onto the ground and bruised or damaged. Moreover, dropped fruit does not have to be collected by other workers from the ground. Because the fruit or produce is not stored within each bucket, the lift arm does not have to be repeatedly raised and lowered to empty a full bin or container. Improved, faster, more efficient and more complete manual harvesting is achieved.

The forward and rearward lift arms and attached buckets located on the right-hand side of machine 10 operate in a analogous manner. As a result, the trees in row R2 are harvested quickly and efficiently in a manner similar to row R1. Each item of fruit picked by worker W2, W4 is deposited into its associated funnel and transmitted by its associated conduit 50 into receptacle 44. Once again, the worker does not have to drop the fruit onto the ground or deposit it into a bin within the bucket which must be regularly emptied. The above described benefits are thereby provided in connection with row R2.

Chutes 52 are located directly on receptacle 44 and are relatively close to the ground. Workers located at a lowermost or ground level are thereby able to pick fruit or produce from the trees in rows R1 and R2 at ground level and deposit those items directly into the receptacle throughout chutes 52 located on either side of the receptacle. Through the use of the opposing upper level forward buckets 40, intermediate level rearward lift arms 30 and ground level chutes 52, three height levels of harvesting may be performed simultaneously. Workers W1 and W2 in forward buckets harvest the upper levels of the trees; workers W3 and W4 in rearward buckets 40 harvest the intermediate levels of the trees; and workers located on the ground level harvest the trees and deposit the picked fruit through chutes 52 directly into receptacle 44.

As best shown in FIG. 4, after fruit F is discharged or deposited into receptacle 44, it collects on conveyor 46 and is transmitted in the direction of arrow 80 outwardly through rear opening 60 of receptacle 44. The fruit is then passed onto elevating conveyor 62. This conveyor transmits the fruit to a standard GOAT apparatus that may be attached to or

follow machine 10. The GOAT is filled, it may be replaced by an empty GOAT. Uninterrupted harvesting is thereby achieved.

Machine 10 provides for a number of significant advantages in the fruit harvesting and agricultural industries. Because the workers are quickly and easily positioned and maneuvered about the trees, less workers are required for harvesting. Labor costs and worker problems are reduced considerably. At the same time, the fruit or produce is manually harvested so that the problems associated with fully automated equipment are avoided. In particular, a more complete harvesting is accomplished and less fruit is missed and wasted. Moreover, there is little, if any damage caused to the fruit by the machinery. The use of the conveniently operated lift arms and attached buckets also enables fruit and other produce to be picked conveniently and much more safely than has heretofore been possible. Ladders commonly used in fruit harvesting and the risk of falls and resulting injuries are eliminated. As previously described, the grove or orchard may be covered quickly, completely and efficiently in a predetermined and virtually automated manner. Unlike any other harvesting machine, the apparatus of this invention enables a pair of adjacent rows in a grove or orchard to be harvested simultaneously. Harvesting efficiency and productivity are thereby improved significantly. Individual items are picked manually but are otherwise transmitted and collected by the machine without requiring additional workers to pick up and transfer the produce. The harvesting process is automated significantly so that labor costs are reduced; however, the benefits resulting from manual harvesting are maintained at the same time.

It should be understood that various alternative features may be employed within the scope of this invention. While the upper end of each conduit is described as connected to a respective carrier bucket, this means that the upper end of the conduit is attached to the bucket either directly, as described above, or indirectly, such as to the upper end of the associated lift arm or the structure interconnecting the lift arm and the bucket. It is important that the upper end of the conduit be conveniently accessible to the worker within the bucket so that picked fruit or produce may be deposited into the conduit, through a funnel or otherwise, and thereby transmitted conveniently and with minimal damage to the receptacle. The precise location at which the conduit is secured is not a limitation of the invention.

From the foregoing it may be seen that the apparatus of this invention provides for a system for harvesting tree grown fruit and produce. While this detailed description has set forth particularly preferred embodiments of the apparatus of this invention, numerous modifications and variations of the structure of this invention, all within the scope of the invention, will readily occur to those skilled in the art. Accordingly, it is understood that this description is illustrative only of the principles of the invention and is not limitative thereof.

Although specific features of the invention are shown in some of the drawings and not others, this is for convenience only, as each feature may be combined with any and all of the other features in accordance with this invention.